Wave induced synergetic electron acceleration in inhomogeneous solar plasmas

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Suprathermal electron populations are generated efficiently in uniform space plasmas by resonant Landau interaction with broadband Alfvén wave spectra. Based on a simulation of the particle acceleration in response to the wave energy input within the Fokker-Planck formalism, details of the time evolution of the velocity space distribution towards commonly observed solar wind power law spectra are discussed. Furthermore, it is shown that the diffusion properties and consequently the particle energization change significantly in astrophysical environments with magnetic field and density gradients, since synergetic effects become dominant. Electrons are accelerated resonantly out of the bulk of the distribution such that they interact again with a wave packet of higher phase velocity, leading to a multi-stage energization. Hence, a unique acceleration mechanism can be achieved without postulating pre-acceleration by ad hoc mechanisms.

Depending on the density and magnetic field profile, significant enhancement of energetic particles as well as stagnation in a saturated stage of suprathermal, non-Maxwellian velocity space distributions is possible. The importance of synergetic acceleration in complex solar flare structures and for solar wind heating mechanisms is discussed in relation to spacecraft observations.